Chapter Three – Operational Analysis Methodology

3.0 INTRODUCTION

Operational analysis is the process of measuring and evaluating the ability of vehicles, pedestrians and bicycles to travel along, across or within a roadway. At the onset of the University Avenue Mobility Plan, three goals were established:

- Meet City of San Diego Traffic Impact Study Guidelines
- Generate Visual Simulations to Illustrate Operations
- Realistically Report Separate Traffic and Transit Operations

This chapter summarizes the methodology used to evaluate the operations of the Preferred Concept Plan. Based on the results of the operational analysis, alternatives to the Preferred Concept Plan were developed to further improve the overall operations along the corridor. Each alternative was further evaluated based on the measures of effectiveness (MOE's) outlined in this chapter.

The SANDAG traffic model was used to help forecast future daily and intersection traffic volumes in the study area. The VISSIM software program was used to measure travel time and intersection delay for all study intersections along the corridor. VISSIM is a micro-simulation traffic model that is capable of generating two-dimension and three-dimension models of traffic flow based on traffic volumes, signal timing and intersection geometry. The VISSIM traffic model generates average travel time and delay. The results are based on multiple model runs that simulate a range of potential traffic operations scenarios over two-peak hour periods, 7:00 to 9:00 a.m. and 4:00 to 6:00 p.m.

After a thorough review of the MOE's reported for each of the alternatives, the alternative with the greatest overall balance of travel time and delay among the various modes and users along the corridor was identified as the Refined Concept Plan. The Refined Concept Plan was then reviewed to ensure that the plan met the initial traffic calming goals, as outlined in Chapter 1 of this document.

3.1 CITY OF SAN DIEGO TRAFFIC IMPACT ANALYSIS REQUIREMENTS

Generally, the purpose of a traffic impact analysis study is to forecast, describe, and analyze the traffic and transit effects a development will have on the existing and future circulation infrastructure. A traffic impact analysis quantifies the changes in traffic levels and translates these changes into transportation system impacts in the vicinity of a project.

In the San Diego region, a traffic impact analysis is typically required when a project is expected to generate 1,000 total average daily trips (ADT) or 100 peak-hour trips. However, when a project does not conform to the land use and/or transportation element of the general or community plan, thresholds of 500 ADT or 50 peak-hour trips are typically used.

This project is unusual in the fact that the proposed project, "University Avenue Mobility Plan" would result in the reduction in vehicle capacity, even as the intensification of land use along the corridor continues.

The following scenarios were analyzed to determine the impacts of the proposed changes in roadway capacity along the corridor:

- Existing Conditions
- Year 2010 Conditions with Existing Intersection Geometry
- Year 2010 with Preferred Concept Plan
- Horizon Year Conditions with Existing Intersection Geometry
- Horizon Year with Preferred Concept Plan

According to City standards, intersections are typically analyzed using the Highway Capacity Manual (HCM) methodology. Several software packages, such as Traffix, Synchro, and HCS, are available to evaluate traffic signals with the HCM methodology. The HCM methodology peak hour intersection analysis calculates the average delay per vehicle for all approaches of an intersection in the case of signalized and all-way stop intersections and for the stop-controlled approach only in the case of a minor street stop-controlled intersection. A letter designation ranging from A through F is then associated to the intersection operations based on a set of delay ranges. Levels of service (LOS) A, B, and C are generally considered acceptable, LOS D is considered marginal, and LOS E and F are considered unacceptable. Table 3-1 presents the delay range for LOS A through F at signalized and unsignalized intersections.

Table 3-1
Intersection LOS & Delay Ranges

LOS	Delay (seconds per vehicle)	
	Signalized Intersection	Unsignalized Intersection
A	0.0 – 10.0	0.0 – 10.0
B	>10.0 – 20.0	>10.0 – 15.0
C	>20.0 – 35.0	>15.0 – 25.0
D	>35.0 – 55.0	>25.0 – 35.0
E	>55.0 – 80.0	>35.0 – 50.0
F	>80.0	>50.0

Source: 2000 Highway Capacity Manual.

Roadway segment operations are generally evaluated by comparing existing and forecast average daily traffic levels to daily capacity thresholds. Daily capacity thresholds vary based on the street classification which is determined by functionality, roadway width, and the number of travel lanes. Table 3-2 presents the various street classifications and associated daily traffic thresholds for LOS A-E as published in the

City of San Diego Traffic Impact Study Manual (TISM). A roadway is considered to operate at LOS F if the daily volumes exceed the LOS E threshold. The TISM indicates that the volumes and the average daily levels of service listed in Table 3-2 are only intended as a general planning guideline. The table does not take other factors that affect actual roadway capacity into consideration, such as lane widths, presence of a raised median, presence of driveways, number and spacing of cross streets, traffic controls, presence of parallel or angled parking, grade, etcetera.

Table 3-2
Roadway Classifications, LOS, and ADT Thresholds

Street Classifications (# Lanes)	Levels of Service				
	A	B	C	D	E
Expressway (6)	30,000	42,000	60,000	70,000	80,000
Prime Arterial (6)	25,000	35,000	50,000	55,000	60,000
Major Arterial (6)	20,000	28,000	40,000	45,000	50,000
Major Arterial (4)	15,000	21,000	30,000	35,000	40,000
Secondary Arterial/Collector (4)	10,000	14,000	20,000	25,000	30,000
Collector, no center lane (4); continuous left-turn lane (2)	5,000	7,000	10,000	13,000	15,000
Collector, no fronting (2)	4,000	5,500	7,500	9,000	10,000
Collector, Commercial-industrial fronting (2)	2,500	3,500	5,000	6,500	8,000
Collector, multi-family (2)	2,500	3,500	5,000	6,500	8,000
Sub-Collector, single-family (2)	-	-	2,200	-	-

Source: City of San Diego Traffic Impact Study Manual

A project is considered to cause a significant impact at an intersection if the average delay at the intersection increases by two or more seconds per vehicle with the addition of the proposed project. A project is considered to cause a significant impact on a roadway segment if the volume-to-capacity (V/C) ratio increases by 0.02 or more with the addition of the proposed project. If a project is found to significantly impact a component of the roadway network, improvements that would mitigate the impact must be identified.

3.2 WHAT MAKES THIS PROJECT DIFFERENT

The University Avenue Mobility Plan (UAMP) project is not a typical traffic analysis. Rather than focusing on the change in land use, the study focuses on the reduction in capacity along the corridor as the change in land use intensifies over the next 30 years. Perhaps the most significant feature of the Preferred

Concept Plan that would affect circulation patterns in the project vicinity is the reduction of mixed-flow travel lanes on University Avenue from two lanes to one lane in each direction and the provision of a transit-only lane in each direction.

In order to understand the effects of the plan to the University Avenue corridor, an expanded assessment beyond the isolated intersection analysis (HCM) and daily roadway traffic level thresholds was necessary because those alone are not sensitive to the factors that affect operations along the corridor. In addition to the City's traffic study requirements the traffic operations of the corridor were also analyzed using VISSIM software that allowed for the comparison of additional measures of effectiveness.

3.3 VISSIM – WHAT IS IT?

The VISSIM analysis software is a microscopic model capable of simulating multi-modal traffic flows, including cars, trucks, buses, heavy rail, light rail, bicyclists, and pedestrians. The simulation capabilities of VISSIM are unlike typical HCM methods of analysis in that VISSIM tracks the individual vehicle interactions in the study corridor that affect overall operating conditions. Because of this, VISSIM quantifies overall and individual intersection delays more realistically, as well as other measures of effectiveness, such as travel time for specific vehicle types and intersection delay for specific vehicle types, amongst others. In addition, VISSIM measures the effects of transit signal priority measures so that their effectiveness can be evaluated at individual intersections.

VISSIM was selected as an analysis tool because it is sensitive to the conditions that affect transit and traffic operations along the corridor, and allows passenger vehicle and transit travel characteristics to be quantified separately. The measures of effectiveness used in this analysis are presented in the following section.

3.4 ESTABLISHED MEASURES OF EFFECTIVENESS

Traffic

The HCM methodology is the most widely accepted and familiar tool for analyzing intersection operations in the San Diego region. As such, the measure of effectiveness (MOE) of overall intersection delay using the HCM methodology is reported for the base and Preferred Concept Plan scenarios. VISSIM was used to report additional MOE's for the base and Preferred Concept Plan scenarios as well as for all alternative concept plan scenarios. The traffic MOE's are as follows:

- Intersections Delay (HCM Methodology and Simulated by VISSIM): Average delay for all approaches of an intersection, reported in seconds per vehicle.
- Roadway Segment Daily Volume-to-Capacity (V/C) Ratios (City ADT Thresholds): Reports a Level of Service (LOS) based on daily traffic levels and associated capacity thresholds.

- Passenger Vehicle Travel Time (VISSIM): Time it takes to travel from one end of the corridor to the other, reported in minutes per vehicle.
- Concurrent Intersection Delay (VISSIM): Delay associated with vehicles approaching an intersection from University Avenue, reported in seconds per vehicle.
- Conflicting Intersection Delay (VISSIM): Delay associated with vehicles approaching an intersection from the side street (not University Avenue), reported in seconds per vehicle.
- Person Delay (VISSIM): Amount of delay at an intersection in seconds per person (rather seconds per vehicle).
- Stops per Vehicle (VISSIM): Number of stops per vehicle along the corridor.

Transit

The Preferred Concept Plan provides for transit-only lanes and transit signal priority measures at signalized intersections. Additionally, a reduction of total transit stops and relocation of specific stops from nearside (before the intersection) to far-side (after the intersection) locations would affect transit operations along the study corridor. Some MOE's listed below are summarized qualitatively. For others, the VISSIM software was utilized to quantify results. The transit-specific MOE's are as follows:

- Transit Vehicle Travel Time (VISSIM): Time it takes for a transit vehicle to travel from one end of the corridor to the other, reported in minutes per vehicle.
- Transit Delay (VISSIM): Average Weighted delay time based on the number of transit vehicles and total delay imposed to transit vehicles during the peak hour.
- Stops per Transit Vehicle (VISSIM): Number of stops per transit vehicle along the corridor. Stop time is measured any time a bus slows to a speed of less than five miles per hour, including stops due to red lights, slowing due to merging or traffic queues and dwell time at scheduled bus stops.
- Transit Passenger Accessibility: Evaluates the effects of consolidating transit stops along the corridor.

Pedestrians

The walkability of the corridor under existing and Preferred Concept Plan conditions were reviewed and evaluated based on several different criteria as listed below. Based on the findings, recommendations to further enhance the walkable nature of the corridor were proposed. The pedestrian MOE's are as follows:

- Frequent Crossing Locations: Identifies the spacing of available crossing locations along the corridor.
- Clear Pavement Markings/Visiblity: Identifies whether pedestrian crossings are clearly marked and identifiable for pedestrians and drivers in their vehicles.
- Crossing Distance: Determines crossing widths and the need for center median refuge areas.

Bicycles

Bicycle circulation in the study area was reviewed and evaluated for existing and Preferred Concept Plan conditions based on several different criteria as listed below. The bicycle MOE's are as follows:

- Capacity: Identifies whether University Avenue would provide sufficient buffer space to permit bicycle use.
- Midblock Crossings: Identifies potential bicycle crossings across University Avenue and the effect that potential proposed raised medians would have.
- Linkage to Bicycle Master Plan: Evaluates potential alternative routes in the study area and whether direct linkage is provided to the study corridor.